

Buttress threads

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Foreword

This standard includes reference to the following British Standard:—

BS 1044, *Recommended designs for plug, ring and gap gauges*.

This British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee at the request of the Ministry of Supply, following the Anglo-American-Canadian Conferences on the unification of engineering standards held during 1943-5.

It provides for a standard form of thread and gives formulæ for calculating suitable allowances and tolerances. A recommended system of gauging is also included.

In selecting the form of the standard thread, manufacture by the thread milling or grinding processes has been taken into consideration. Appendix A gives details of an alternative form of thread which is unsuitable for manufacture by these two methods but which may be required to meet certain special requirements.

This standard includes preferred series for the diameters and numbers of threads per inch of buttress threads but, as the use of buttress threads is confined mainly to specially designed components, no attempt has been made to introduce a rigid pitch/diameter relationship.

The buttress form of thread has certain advantages in applications involving exceptionally high stresses in one direction only, along the thread axis. As the thrust side of the thread is made very nearly perpendicular to the thread axis, the radial component of the thrust is reduced to a minimum and a solid bearing between the mating threads is produced. On account of this small radial thrust the buttress form of thread is particularly suitable when tubular members are screwed together. Examples of actual applications are the breech mechanisms of large guns, aeroplane propeller hubs, and columns for hydraulic presses.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 20 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard relates to screw threads of buttress form and provides:

- a) a standard form of thread
- b) tables of preferred diameters and of preferred pitches
- c) a formula for calculating effective diameter tolerances
- d) tolerances for major and minor diameters
- e) a system of allowances between mating threads
- f) recommended methods of gauging
- g) Appendix A giving a special form of buttress thread having a vertical pressure flank
- h) Appendix B giving notes on the effective diameter equivalents of pitch and angle errors
- i) Appendix C giving notes on the measurement of the effective diameters of buttress threads.

2 Definitions

For the purpose of this British Standard, the contacting flank of the thread which takes the thrust is referred to as the “pressure flank” and the clearance flank as the “trailing flank”.

3 Basic form of thread

The basic form of the British Standard buttress thread is shown in Figure 1, page 6.

Table 1 gives the numerical data for buttress threads with reference to the designating letters in Figure 1.

4 Preferred diameter series

It is recommended that the nominal (major) diameters should be selected wherever possible from the series given below. These nominal (major) diameters relate to the screws at their maximum metal condition, assuming no allowance between maximum screw and minimum nut.

Nominal diameter in inches				
1	2	4	8	16
1 $\frac{1}{8}$	2 $\frac{1}{4}$	4 $\frac{1}{2}$	9	18
1 $\frac{1}{4}$	2 $\frac{1}{2}$	5	10	20
1 $\frac{3}{8}$	2 $\frac{3}{4}$	5 $\frac{1}{2}$	11	22
1 $\frac{1}{2}$	3	6	12	24
1 $\frac{3}{4}$	3 $\frac{1}{2}$	7	14	—

5 Preferred pitch series

It is recommended that the number of threads per inch should be selected from the following series. Those given in parentheses are not recommended for general use.

Threads per inch			
20	8	3	(1 $\frac{1}{4}$)
16	6	(2 $\frac{1}{2}$)	1
12	(5)	2	—
10	4	1 $\frac{1}{2}$	—

The following suggestions are made regarding suitable associations of diameters and pitches:—

Nominal diameters in inches	Threads per inch
From 1 up to and including 4	20, 16, 12, 10, 8 or 6
Above 4 up to and including 6	16, 12, 10, 8, 6 or 4
Above 6 up to and including 10	12, 10, 8, 6, 4 or 3
Above 10 up to and including 16	8, 6, 4, 3, 2 or 1 $\frac{1}{2}$
Above 16 up to and including 24	6, 4, 3, 2, 1 $\frac{1}{2}$ or 1

6 Tolerances

Tolerances on screws are applied in a negative direction and on nuts in a positive direction (see Figure 2 and Figure 3, pages 10 and 11).

a) *Tolerances on effective diameter.* The following formula is used for determining the effective diameter tolerances for screws and nuts:—

Medium class effective diameter tolerance for screw or nut

$$= 0.002 \sqrt[3]{D} + 0.00278 \sqrt{L} + 0.00854 \sqrt{p}$$

where D = basic major diameter of screw (assuming no allowance)

L = length of engagement

p = pitch of thread.

If the length of engagement is taken as 10p the above formula reduces to:

$$0.002 \sqrt[3]{D} + 0.0173 \sqrt{p}.$$

Using this latter formula the effective diameter tolerances for various combinations of pitch and diameter are given in Table 2, Table 3 and Table 4.

Error in the pitch and the flank angles of a thread virtually increase the effective diameter of a screw and decrease the effective diameter of a nut. The limits stated in the tables apply both to the simple effective diameter (as measured along the pitch line of the thread) and to this diameter as virtually increased (for screws) or decreased (for nuts) by the diametral equivalent of any errors present in the flank angles and in the pitch over the length of engagement.

The use of the GO and NOT GO screw gauges recommended in Clause 9 ensures for all practical purposes that the above requirements are satisfied.

It is to be noted that the foregoing formula relates to tolerances for medium class; close class tolerances are two-thirds of the medium class tolerances, and free class tolerances are 1½ times the medium class tolerances.

b) *Tolerances on major diameter of screw and minor diameter of nut.* Unless otherwise specified these tolerances should be the same as the effective diameter tolerance for the class used. The necessity of reducing these tolerances may arise in cases where the crest surfaces of the screw and nut form datum surfaces for the measurement of thread angles or pitch, as in large diameter threads, or where the resulting reduction in the depth of engagement has to be limited. In these particular cases the following tolerances are recommended:—

Nominal diameter in inches	Tolerance on major diameter of screw and minor diameter of nut, in inches
From 1 to 1½	0.002
Over 1½ to 2½	0.002 5
Over 2½ to 4	0.003
Over 4 to 6	0.004
Over 6 to 16	0.005
Over 16 to 24	0.006

c) *Tolerances on minor diameter of screw.* It is important that at the minor diameter of the screw there should be a well formed radius. Unless otherwise specified the tolerance on the minor diameter of the screw shall be twice the effective diameter tolerance.

d) *Tolerances on major diameter of nut.* It is preferable that the root of the nut should be of rounded form. Unless otherwise specified the tolerance on the major diameter of the nut shall be twice the effective diameter tolerance.

7 Allowances for easy assembly

An allowance (clearance) should be provided on all buttress screws in order to secure easy assembly of parts. The amount of the allowance is deducted from the nominal major, effective, and minor diameters of the screw member in order to determine the maximum metal condition of the screw.

The minimum nut is basic.

The amount of the allowance is the same for all three classes and is equal to the close class effective diameter tolerance as calculated under Clause 6 a) above. The allowances for various combinations of pitch and diameter are given in Table 5.

Example:

Screw and nut. Standard thread form. Medium class 2 in. nominal diameter (D). 8 t.p.i.

Screw:

Allowance	= G	= 0.0058 in.	Table 5
Maximum major diameter	= D – G	= 1.9942 in.	
Maximum effective diameter	= D – B – G	= 1.9442 in.	Table 1
Maximum minor diameter	= D – 2A – G	= 1.8678 in.	Table 1

Nut:

Minimum major diameter	= D – 2B + 2A	= 2.0264 in.	Table 1
Minimum effective diameter	= D – B	= 1.9500 in.	Table 1
Minimum minor diameter	= D – 2B	= 1.9000 in.	Table 1

Tolerances for screw:

Major diameter	– 0.0087 in.	Table 3
Effective diameter	– 0.0087 in.	Table 3

Tolerances for nut:

Effective diameter	+ 0.0087 in.	Table 3
Minor diameter	+ 0.0087 in.	Table 3

Limits for medium class:

Screw. Major diameter	1.9855 in. and 1.9942 in.
Effective diameter	1.9355 in. and 1.9442 in.
Minor diameter	not greater than 1.8678 in.
Nut. Major diameter	not less than 2.0264 in.
Effective diameter	1.9500 in. and 1.9587 in.
Minor diameter	1.9000 in. and 1.9087 in.

Figure 2 shows the relative tolerances and allowances in diagrammatic form for the three classes, applied to the size of thread 2 in. diameter $\times$ 8 t.p.i. in the above example.

8 Designation of British Standard buttress threads

It is recommended that the following system should be adopted for designating the threads.

If the thread is required to conform to the appropriate tolerances and allowances in Table 2 to Table 5 and to the normal tolerance on major diameter of screw and minor diameter of nut [Clause 6 b)], the designation should be in the general form:

2.0 BS Buttress thread 8 t.p.i. medium class.

NOTE If a non-standard allowance and/or tolerance on the major diameter of the screw and minor diameter of the nut is used, the designation should carry the additional note “(special fit)” and the actual limits of size for the major diameter of the screw or minor diameter of the nut should be indicated on the drawing, or in relevant correspondence, e.g.,

2.0 BS Buttress thread (standard form) 8 t.p.i. medium class (special fit.)

$$\begin{aligned} \text{Major diameter (of screw)} &= \begin{cases} 1.998\ 0 \\ 1.995\ 5 \end{cases} \\ \text{or Minor diameter (of nut)} &= \begin{cases} 1.902\ 5 \\ 1.900\ 0 \end{cases} \end{aligned}$$

This implies an allowance of 0.002 in., and a tolerance on major diameter of screw, or minor diameter of nut, of 0.002 5 in. [Clause 6 b)].

It is obvious that either the allowance, or the tolerance, or both may be changed from standard, but the same method of designation suffices. If the allowance only is altered, only the screw requires the special method of designation.

9 Recommended gauging practice

To ensure that the sizes of the threads are between their allowable limits, the use of the following gauging system is recommended. The design sizes to which the gauges are made are given in Table 6, and the thread forms of the gauges are illustrated in Figure 4.

A. For screws

- i) A GO *screw ring gauge* made to the maximum permissible effective diameter of the screw and having the same thread form as a maximum metal nut, with a flat crest. The theoretical length of thread of this gauge should be not less than the length of engagement of the component threads, but as it is usual to make screw ring gauges from British Standard gauge blanks¹⁾ it is assumed that this practice is allowable, unless otherwise stated on the drawing.
- ii) A NOT GO *effective (pitch) diameter screw ring or calliper gauge* made to the minimum permissible effective diameter of the screw. The thread form of this gauge has a truncated flat crest and a cleared root so that it bears on the middle part of the flanks. The root clearance should be such as to clear the maximum major diameter of the screw. The length of thread of this gauge is limited to two or three pitches.
- iii) A GO *plain calliper gauge* made to the maximum permissible major diameter of the screw.
- iv) A NOT GO *plain calliper gauge* made to the minimum permissible major diameter of the screw.

NOTE It may be convenient to combine the calliper gauges specified in sub-sections iii) and iv) above as a single “progressive” calliper gauge.

B. For nuts

- i) A GO *screw plug gauge* made to the minimum permissible effective diameter of the nut and having the same thread form as a maximum metal screw, with a flat crest. The theoretical length of thread of this gauge should be not less than the length of engagement of the component threads, but as it is usual to make screw plug gauges from British Standard gauge blanks it is assumed that this practice is allowable, unless otherwise stated on the drawing.
- ii) A NOT GO *effective (pitch) diameter screw plug gauge* made to the maximum permissible effective diameter of the nut. The thread form of this gauge has a truncated flat crest and a cleared root so that it bears on the middle part of the flanks. The root clearance should be such as to clear the minimum minor diameter of the nut. The length of thread of this gauge is limited to two or three pitches.
- iii) A GO *plain plug gauge* made to the minimum permissible minor diameter of the nut.
- iv) A NOT GO *plain plug gauge* made to the maximum permissible minor diameter of the nut.

NOTE It may be convenient to combine the plain plug gauges specified in sub-sections iii) and iv) above as a single “progressive” plug gauge.

¹⁾ BS 1044, “Recommended designs for plug, ring and gap gauges.”